<u>**REMARKS**</u>

Claims 1-26 were currently pending in the present application.

Claims 27 and 28 have been added by this present amendment.

<u>**Objections to the Specification:**</u>

The Examiner objects to the specification because of the following informality – (1) paragraph [01] is missing several serial numbers of referenced applications; (2) in the Abstract, the content is inconsistent with the description of the invention and (3) in paragraph [030], the Examiner finds that the label for element 302 of Fig. 3. is inconsistent with the element feature.

As to paragraph [01], Applicant believes that the corrective amendment to paragraph [01] has been made.

As to the Abstract, Applicant respectfully disagrees with the Examiner for several reasons. First, as a threshold matter, the Abstract is a part of the original specification and, as such, forms a part of the descriptive subject matter. Additionally, the Claims are also a part of the original specification and form a part of the descriptive subject matter.

Even though that alone should be sufficient to traverse the present objection to the recitation of three colors C1, C2 and C3 that may be different from R, G and B, there is additional support in the specification.

Applicant directs the attention of the Examiner to paragraph [011] of the present specification. Applicant reproduces paragraph [011] for the convenience of the Examiner:

"[0011] One embodiment of the present RGBW conversion system proceeds as if there are 4 primaries, but divides the chromaticity diagram into three triangles. FIG. 1 shows the general situation--with RGBW primaries within the CIE color chart. **Of course, it will be appreciated that the present system and techniques will work for any 4-color primary system with W as one of**

the primaries (e.g. CMYW and the like). With such a system, one possible solution for RGBW arises from the three matrices that each have coefficients for the fourth primary which will linearly interpolate white values from 0 at the primary base of the triangles to 1 at the white-point. It will be appreciated that—although triangles are a natural choice for the regions bounded by W and two of R, G, and B—other regions are possible for purposes of the present invention. It will also be appreciated that there may be more than three non-white primaries."
(**Bold** emphasis added)

Clearly, as shown in paragraph [011] above, the present application contemplates the use of primaries other than R, G and B. This is also reflected in Claims and Abstract as filed.

Applicant respectfully requests that the present objection be removed.

As for the informality of paragraph [030] as indicated by the Examiner, Applicant believes that -- although the label for element 302 states "3 x n" for a 3 input, 4 output element – this is not inconsistent with the text of the specification. For example, Applicant directs the attention of the Examiner to the last sentence of paragraph [011] as reproduced above. There, it is recited that: "[i]t will also be appreciated that there may be more than three non-white primaries."

Thus, Applicant believes that the current label is correct and not in need of amendment.

Applicant believes that all informalities have now been appropriately addressed.

Double Patenting:

The Examiner rejects Claims 1 and 15 on the grounds of the nonstatutory obviousness-type double patenting, as being unpatentable over Claims 1-3 and 11-13 of co-pending Serial Number 10/691,396, a co-pending and co-owned application.

Specifically, the Examiner avers that the subject matter claimed in the instant application is fully disclosed in the referenced co-pending application and would be covered by any patent

granted on such co-pending application. Applicant notes that the present rejection to Claims 1 and 15 are provisional – as the conflicting claims are not as yet patented.

As to currently amended Claims 1 and 15, Applicant respectfully traverses the present rejection.

Applicant has now amended Claims 1 and 15 in a manner that may have mooted the double patenting rejection and obviated the need for a terminal disclaimer. Claims 1 and 15 now recite steps and circuitry respectively for the detection of mapped color image data that is out-of-gamut and to effect a change to bring such data back into gamut.

The claims of copending Serial Number 10/691,396 do not reflect such claim limitations and, as such, Applicant believes that that the current rejection under double patenting has now been overcome.

Claim Rejection Under 35 USC 112:

Claims 1 and 15:

The Examiner rejects Claims 1-15 under 35 USC section 112, first paragraph as failing to comply with the enablement requirement.

Specifically, the Examiner states that the Claims contain subject matter which was not described in the specification. In particular, the Examiner notes that the method and system for converting image data set from a color space comprising C1, C2, C3 to a color space C1, C2, C3 and W are not described in the specification.

Instead, the Examiner finds that that the conversion from RGB to RGBW is described in the specification – and the Examiner recommends that Applicant amend the Claims accordingly.

As mentioned above with respect to the informalities, Applicant directs the Examiner's attention again to the paragraph [0011] and Applicant's assertion that the system and techniques that are described herein for RGB to RGBW conversion are applicable to systems of three primaries (not necessarily all of the RGB) to such three primaries and as an additional primary.

As such, Applicant believes that sufficient disclosure exists in the present specification to enable one skilled in the art to make and/or use the invention of Claims 1 and 15.

In addition, the Examiner has rejected Claims 1 and 15 under 35 USC section 112, second paragraph, as having certain antecedent basis problems.

Applicant avers that current amendments to Claims 1 and 15 have supplied the appropriate correction.

Claim Rejections Under 35 USC 103:

The Examiner rejects Claims 1-9 and 15-22 under 35 USC section 103(a) as being unpatentable over Childs (GB 2282928) in view of Murdock (USP 6,897,876).

Claims 1 and 15:

Specifically, as to Claims 1 and 15, the Examiner finds that Childs teaches a method and a system (decoding circuit) for converting a three-color image data set (video signal) to four-color image data set (see Fig. 4 and lines 17-20 on page 12) by dividing (dissecting) the color space into regions (triangles (see lines 9-10 on page 6), and determining the mapping form the three-color image data points to four-color image data points (a set of numerical solutions) (see lines 19-20 on page 13 and Appendix 1 on page 25). Childs uses the white point in his computation (see D65 in Fig. 3, and last three lines on page 5 and equation 1f on page 6).

The Examiner, however, finds that Childs does not teach that W is used as a primary color in the target (four-color after conversion) color space. The Examiner, though, finds that Murdock teaches a method for converting three color (R G B) image data set (input signals) to four color (R' G' B' W) image data set (output signals) (see col. 3, lines 49-54 and col. 4, lines 56-61), where W is the white color for the benefit that employing a while OLED along with the red, green, blue OLEDs to improve power efficiency and/or luminance stability of displaysover time (col. 1, lines 26-28).

Therefore, the Examiner concludes, it would have been obvious to convert a three-color image data set into a four-color image data set, be divding a color space into regions and

determine a mapping from image data points comprising three colors to image data points comprising four colors with one of the colors as W for the benefit of improving power efficiency and/or luminance stability of displays over time.

As to Claims 1 and 15, Applicant respectively traverses the present rejection.

As a threshold matter, Claims 1 and 15 contain the limitation that the target color space be divided into "regions bounded by W and two of a group, said group comprising: C1, C2 and C3". This feature is clearly seen, for one exemplary embodiment, in Figure 1 of the present application – with W as one of the vertices of the regions.

Applicant avers that neither Childs nor Murdock disclose this particular limitation.

In addition, Applicant amends Claims 1 and 15 to contain the limitations that the target color space be divided into sets of non-overlapping regions. This further distinguishes the present inventions in the and, as will be discussed further herein, such a claimed invention offers results that are neither anticipated nor predicable from the combination of prior art references of record.

By contrast, Childs – not only does not use an interior point (e.g. W) as a bounding point for regions – but in addition, effectively teaches away from the use of non-overlapping regions because Childs actually constructs individual multipliers for each region (see Childs at Figure 4, page 12 – note individual matrix arithmetic units 12, 14 and 16). Overlapping regions in Childs leads to a reduction in the number of multipliers. By contrast, the present application envisions a single multiplier – thus, there is no need to reduce the number of multipliers. Towards that end, Childs calculates all possible solutions and then selects the solution set that does not contain negative values:

> "The multi-primary problem can be overcome by dissecting the colour
> gamut of the display into triangles formed by sets of three of the display
> primaries, and using any analysis which produces only positive drive signals.

Unfortunately, not all of the triangles thus formed will contain the balance point of the system and so the mathematics of Section 2 cannot be used directly, also it may be difficult to set up the display device in practice. For a multi- primary display there are several solutions to this.

The display may be made using three primaries at a time forming triangles which do not overlap; overlapping triangles are then required only for setting up the display. This approach, of using contiguous non- overlapping triangles, might cause some difficulties if the implementation of the following mathematics is not sufficiently accurate; noise could cause fast switching between triangles resulting in unfamiliar effects.

As an alternative, overlapping triangles can be used and the switching between triangles can then employ hysteresis to avoid these effects. It is possible to calculate an analysis for a triad which uses two real primaries and one synthetic primary, made by linearly mixing two others .

The calculation processes required to produce the matrices which connect the transmission signals with the display primaries is as described in Section 2. The concept of balancing each display primary triad individually to an illuminant is retained, even though not all of the triads contain the white point. Any triad not containing the white point will produce a column in the display matrix containing only negative numbers, and the appropriate multiplier (l,m or n) is negative. This is only a mathematical problem, and does not render the problem insoluble as is shown below." (Childs at page 8-9).

Applicant avers that Claims 1 and 15 as amended has expanded the differences between Claim 1 and the combination of Childs and Murdock. As the combination of the prior art of record does not render the claimed inventions of Claims 1 and 15 as amended obvious, Applicant respectfully requests that the present rejection to Claims 1 and 15 be removed and that Claims 1 and 15 be moved to allowance.

Claims 2-9 and 16-22:

As Claims 2-9 and 16-22 ultimately depend on allowable Claims 1 and 15 respectively, Applicant respectfully submits that Claims 2-9 and 16-22 are themselves allowable without any further argument for their separate patentability. Applicant reserves all right to submit such arguments in any possible future responses.

As to Claims 3 and 17, however, Applicant notes that the Examiner does not particularly address the rejection of Claims 3 and 17 with respect to Childs in view of Murdock. The closest mention that Applicant can find in the present Office Actions starts at paragraph 21-22 wherein the Examiner states:

"However, Childs ... does not teach that W (white color) is used as a primary color in the target (four-color after conversion) color space.

Murdock ... teaches a method for converting three color (R,G,B) image data set (input signals) to four color (R',G',B', W) image data set (output signals) (see col. 3, lines 49-54 and col. 4, lines 56-61), where W is the white color for the benefit that employing a white OLED ... along with the red, green, blue OLED to improve power efficiency and/or luminance stability of displays over time (col. 1, lines 26-28).

Applicant notes that Claims 3 and 17 particularly contain the limitation that "the regions bounded by W and two of a group, said group comprising C1, C2 and C3 comprises triangles." Applicant respectfully requests that – should the Examiner reinstate the present rejection to Claims 3 and 17 – the Examiner point out the limitation of Claims 3 and 17 with particularity in the references.

As to Claims 4, 5 and 6 as well as Claims 18, 19 and 20, Applicant also finds that the Examiner has not addressed the rejection of these Claims with particularity as well. Applicant respectfully requests that – if the Examiner re-instates this rejection to these Claims, that the Examiner point out these limitations with particularity within the references.

With respect to Claims 8 and 22, Applicant notes that the Examiner finds that equation 3j on page 11 of Childs to be equivalent to the equations in Claims 8 and 22.

Applicant notes that Childs does not appear to disclose using the white point W as one of the primaries – which dovetails with the observation above that Childs does not disclose the use of W as one of the boundary points of a dividing region of the target color space. Applicant requests that the Examiner point out this limitation with particularity, if the Examiner re-instates this rejection of Childs in view of Murdock.

Claims 10-13 and 23-26:

The Examiner rejects Claims 10-13 and 23-26 under 35 USC 103(a) as being unpatentable over Childs and Murdock – as applied to Claims 1-9 and 15-22 above – and further in view of Lin (USP 6,421,142).

Specifically, the Examiner states that Childs and Murdock applied as above with respect to Claims 10 and 23.

The Examiner finds that the combination of Childs and Murdock does not teach detecting four color image data points that are out-of-gamut and effecting a change.

However, the Examiner notes that Murdock discloses that any known gamut-mapping techniques may be applied to do the corrections (col. 6, lines 35-40).

The Examiner, though, finds that Lin teaches a method and system for detecting out-of-gamut (see steps S243, 245, 247 in Fig. 14; and col. 13, lines 51-57) and mapping the out-of-gamut color points into the gamut range (see Fig. 15; col. 14, lines 26-63) for the benefit of improving out-of-gamut mapping in a color reproduction system comprising an input device and an output device (see col. 3, lines 61-62 and col. 4, lines 11-12).

Thus, the Examiner concludes, it would have been obvious to combine the out-of-gamut color mapping after color space conversion as shown in Lin in the previous combination.

As to Claims 10 and 23, Applicant respectfully traverses the present rejection.

As Claims 10 and 23 ultimately depend from Claims 1 and 15 respectfully, Applicants remarks above as to the deficiencies of the combination of Childs and Murdock applied to Claims 1 and 15 apply with same force here.

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Thus, as Claims 1 and 15 are allowable over Childs and Murdock of record, Applicant respectfully avers that Claims 10 and 23 are themselves allowable over the combination in view of Lin, without any additional argumentation for their separate patentability. As such arguments are reserves for use in future responses.

In addition, Applicant notes that Lin does not appear to supply the missing disclosure of the use of the white point W as a boundary point of non-overlapping regions in the target color space – as is required in Claims 1 and 15 of the present application.

Moreover, Applicant notes that Claims 10 and 23 as amended contain the limitation that the change effected is accomplished "as a function of the out-of-gamut coefficients" – Applicant requests that the Examiner point out this limitation with particularity, if the Examiner re-instates the present rejection.

As such, Applicant respectfully request that the present rejection to Claims 10 and 23 be removed and that Claims 10 and 23 be moved through to allowance.

As to Claims 11-12 and 24-25, Applicant avers that, as these Claims ultimately depend from allowable Claims 10 and 23, that these Claims are themselves allowable and the same is respectfully requested.

Claims 13 and 26:

As for Claims 13 and 26, the Examiner posits that it is not clear what is meant by "the maximum allowed value and the "maximum coefficients" or how the "scaling" is performed.

The Examiner makes the following interpretations:

(1) "the maximum allowed value" as a point on the boundary of the color gamut;

(2) "the maximum coefficients" as the coefficients on the interpolations which bring the out-of-gamut color points to the boundary of the color gamut; and

(3) "scaling" as calculating the coefficients of the interpolations.

With the above interpretations, the Examiner finds that Lin teaches this calculation at col. 19, line 40.

With respect to Claims 13 and 26, Applicant respectfully traverse the present rejection.

First, with respect to the interpretations made by the Examiner, Applicant directs the attention of the Examiner to paragraphs [0025-0026] in the present specification:

[0025] It is possible to detect when colors are out of gamut in RGBW (or any multiprimary color space, for that matter) by checking for values that are out of bounds. If color components are calculated on the range 0-255, these out-of-gamut values will be larger than 255. One embodiment clamps all the resulting color components to the maximum allowed value. However, this results in a change in the hue of the resulting color. FIG. 2 shows an example of this effect. The point P is a color that is outside the RGBW gamut and results in out-of-gamut values. If the out-of-gamut values are simply clamped to the maximum allowed values, the resulting color would be color D. It may be more desirable to have the color E as the resulting color which also lies on the edge of the RGBW color gamut but has the same hue as the original color P.

[0026] To calculate the correct color E the following procedure is used: **When an out-of gamut color is detected, the maximum of the four RGBW color components is found. The ratio between the <u>maximum allowed value</u> (usually 255) and the <u>maximum RGBW value</u> is a scale factor that is then used to correct all four of the RGBW components. <u>Scaling</u> all four of the components by the same number preserves hue and results in the correct color E instead of the "simple clamped" color D.**

Applicant avers that – for the exemplary embodiment discloses above – the "maximum allowed value" is fairly self-explanatory and the "maximum coefficient" is seen in the above embodiment description as the "maximum RGBW value". The "scaling" is clearly seen as applying the ratio of the maximum allowed value and the maximum RGBW value to all components.

Given the interpretation as supplied by one embodiment in the specification, Applicant then notes that difference between this disclosure and the Examiner's application of Lin.

The Examiner finds equivalency in Lin at col. 19, line 40. Applicant reproduces -- not only that sentence -- but that entire section regarding Lin's treatment of out of gamut colors.

"5b. Improving Accuracy for Out-of-Gamut Colors

The accuracy of LUT entries for out-of-gamut colors can be improved by obtaining additional patches for selected out-of-gamut colors as required to improve the LUT accuracy in those regions of color space where transform accuracy is more important. These patches may be obtained from another source such as a different output device or by operating a given output device in a different mode, as described above. The coordinates of the point in DICS representing the patch color may be obtained from a measuring device such as a spectral photometer.

Referring to FIG. 17, a method for improving the accuracy of out-of-gamut colors comprises using current LUT entries to obtain an initial estimate of the patch color space coordinates (step S271), comparing the estimated coordinates to the actual (measured) coordinates to obtain the estimation error (step S272), determining if the estimation error is acceptably small (step S273) and, if not, modifying current LUT entries according to the estimation error (step S274). The process terminates (step S275) when the estimation error is acceptably small.

An initial estimate of the coordinates ($[x.sub.S, y.sub.S, z.sub.S]$) in the DICS for a selected out-of-gamut color is obtained by tetrahedral interpolation of the four points closest to the scanned point according to:

[EQUATIONS NOT SHOWN]

where interpolation coefficients [a.sub.1] through [a.sub.4] are determined by the location of the interpolated point relative to the locations of these four closest points.

The estimation errors in the x, y and z dimensions are obtained from the expressions:

[EQUATIONS NOT SHOWN]

where the coordinates x.sub.m, y.sub.m and z.sub.m are known from measurements of the color patch. Alternatively, other measures of estimation error may be used such as the square of the differences shown above.

The coordinates of the four closest points are modified to obtain a lower estimation error. For example, the x coordinates are modified reiteratively according to the following expressions:

[EQUATIONS NOT SHOWN]

where i=index of iteration, and [.eta.] = convergence coefficient.

The y and z coordinates are modified in a similar manner. After each iteration, a new interpolation is performed according to

[EQUATIONS NOT SHOWN]

and a new estimation error is obtained as explained above. The iteration continues until the estimation error is acceptably small.

By using these two techniques, the interpolation accuracy of a LUT for both in-gamut and out-of-gamut colors may be improved without increasing the number of entries in the LUT." (Lin at col. 19, line 8 to col. 20, line 23)

Applicant respectfully submits that Lin is reciting an iterative refinement process for improving the accuracy of processing out-of-gamut colors. Applicant believes that this passage from Lin does not disclose the scaling step as recited in Claims 13 and 26.

As such, Applicant believes the current rejection to Claims 13 and 26 in view of Lin and the other references of record should be removed and the same is respectfully requested.

Claim 14:

The Examiner rejects Claim 14 under 35 USC 103 (a) as being unpatentable over Lin. Specifically, the Examiner posits that Lin covers the Claim 14 as part of his out-of-gamut color mapping strategy.

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The Examiner finds that Lin teaches calculating a scaling factor for out-of-gamut image data points – which the Examiner find equivalent to the coefficients of the interpolations in Lin at col. 19, lines 30-43 – comprising:

an input channel to receive image data points (the input device in Lin – e.g. element 10 in Fig. 1);

maximum coefficient detector (in Lin, the process of projection and clip is to find a corresponding color point on the boundary of the output gamut for the out-of-gamut color point. The unit 87, along with unit 82, performs the function of a maximum coefficient detector and a scaling unit. The "maximum" refers to the chroma magnitude of the largest coordinates (see Lin at col. 14, line 50);

an inverse LUT to store the scaling factors (see Lin at col. 20, lines 19-22); and

a scaling unit (see unit 87 and unit 82 in Fig. 15 of Lin).

As to currently amended Claim 14, Applicant respectfully traverses the present rejection.

For the convenience of the Examiner, Applicant herein reproduces the various Figures and passages of Lin cited by the Examiner above with respect to Claim 14.

Figure 15 of Lin is shown below. Unit 82 (CHECK GAMUTS and unit 87, 88 (PROJ/CLIP CHROMA) are shown therein:
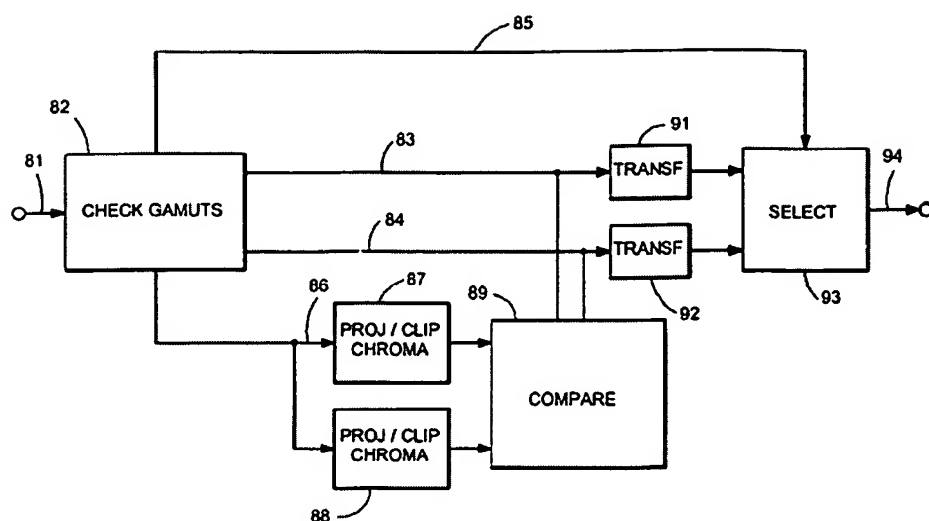
FIG._15

The following excerpt from Lin describes Figure 15 and units 82, 87:

"FIG. 15 illustrates major components of one way for deriving a
transformation in this manner. Check gamuts 82 receives information from path
81 representing one or more points in color space and determines whether a
respective point p is in either or both of two gamuts. If point p is in the first
gamut, information representing that point is passed along path 83 to
transformation 91 which implements inverse function [g1.sup.-1] discussed
above. If point p is in the second gamut, information representing that point is
passed along path 84 to transformation 92 which implements inverse function
[g2.sup.-1] discussed above. If point p is in both gamuts, information is passed to
both transformations and an indication of this is passed along path 85. If point p is
in neither gamut, information representing that point is passed along path 86.

Projection/clip chroma 87 projects lines from point p to the neutral-color
line, determines the intersection or clip point [pi] of this projection with the
boundary of the first gamut using the previously described out-of-gamut mapping
strategy, and determines the chroma for point [p.sub.1]. In one embodiment, the
chroma is determined from the chroma magnitude which, in L*a*b* space, is

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equal to the square root of the sum of the squares of the a* and b* coordinates. **In another embodiment, the chroma is determined from the magnitude of the largest coordinate which, in L*a*b* space is the larger of |a*| and |b*|.** Similarly, projection/clip chroma 88 projects lines from point p to the neutral-color line, determines the intersection or clip point p.sub.2 of this projection with the boundary of the second gamut using the previously described out-of-gamut mapping strategy, and determines the chroma for point p.sub.2.

Compare 89 determines whether point [p.sub.1] or point [p.sub.2] has the larger chroma. If point [p.sub.1] has the larger chroma, compare 89 passes information representing point [p.sub.1] along path 83 to transformation 91. If point [p.sub.2] has the larger chroma, compare 89 passes information representing point [p.sub.2] along path 84 to transformation 92.

Select 93 receives the results of transformation 91 and transformation 92 and, if the indication received from path 85 indicates point p is in both gamuts, generates along path 94 information representing the average of the results received from both transformations. If the indication received from path 85 does not indicate point p is in both gamuts, select 93 generates along path 94 information representing the sum of the results received from both transformations. In this embodiment, it is assumed that if no information is passed to a respective transformation, that transformation produces a result equal to zero; therefore, the sum of the results will be equal to whichever transformation was passed information." (Lin at col. 14, line 26 to col. 15, line 8) (**Bold** emphasis added for Lin at col. 14, line 50).

Claim 14, as currently amended, requires that the inverse look-up table contain inverse values that are functions of the maximum coefficient detected. Applicant directs the attention of the Examiner to paragraph [0029] of the present specification for adequate support for newly amended Claim 14.

Applicant avers that Lin does not disclose this limitation of Claim 14 – and as such, Applicant respectfully requests that the present rejection to Claim 14 be removed.

Conclusion

Based on the foregoing reasons, all Claims, pending after this amendment, are now in condition for allowance. Please telephone the undersigned attorney at (408) 392-9250 if there are any questions.

Respectfully submitted,

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I hereby certify that this correspondence is being transmitted to the United States Patent and Trademark Office (USPTO) via the USPTO's EFS-Web electronic filing system on May 7, 2008.

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